3p.

Status Report
Program of Research in Space Physics
Columbia University
Interdepartmental Grant NsG-445
4-1-63 thru 9-30-63

Research has been conducted under this grant by faculty members and research assistants associated with the Departments of Astronomy, Physics, and Geology, and the Lamont Geological Observatory. The research has been carried on in close association with NASA's Goddard Institute for Space Studies. Drs. Robert Jastrow, Hong-Yee Chiu, and Jackson Herring, members of the Goddard Institute staff with adjunct professorial appointments at Columbia, are among the Columbia faculty members actively engaged in the research supervision of the work of research assistants.

The program of research stresses the following areas: radiative and convective transfer in planetary atmospheres, physics of the upper atmosphere, applications of plasma physics to geophysical and astrophysical problems; stellar structure and evolution; and stellar and galactic dynamics. Specifically, research has been undertaken on the following topics:

1. The Day Airglow and the Heating of the Upper Atmosphere. The rate at which heat is released by the recombination of ions and electrons is being calculated. A closely related calculation predicts the intensities of a number of lines in

the spectrum of the day airglow. Little is yet known about the day airglow because observing techniques have only recently been developed.

2. Energy Loss from Stellar Matter. The rate of this loss caused by neutrino pairs produced in electron-electron scattering is being calculated. Results have been obtained for temperatures and densities at which the electrons behave non-relativistically. The calculation was performed for the extreme cases of degenerate and non-degenerate electron gas. Approximate results for the intermediate conditions have been obtained by interpolating. The calculation is now being extended to conditions of higher temperature and higher density at which the electrons behave relativistically.

3. Neutron Star Models. The abundances at high densities under conditions of statistical equilibrium are being calculated. Theoretical models of the core and atmosphere of a neutron star are being constructed, and the cooling time of such a star is being determined.

4. Star Formation and the Origin of Planetary Bodies. Several problems related to the outer layers of stars are being investigated, and a study of the outer convection gore and the effects of radiation on sound and shock waves. Work on analytic models of evolving stars has also been undertaken,

with the aim of explicating the determining physical factors. A study of the heating of the solar corona and the solar wind during early periods in the sun's life is also planned.

5. Nuclear Astrophysics. Calculation of the rates of the reactions involved in the silicon-to-iron transformation is in progress.

6. Planetary Atmospheres. This work encompasses a study of the various heat sources and sinks which determine temperature in the upper atmosphere, with particular interest in calculation of the temperature of the exosphere of Venus with allowance for cooling by radiation emitted by CO_2. The exospheric temperature controls the rate of escape of gas into space and therefore profoundly affects the composition and density of the atmosphere.

7. Convective Heat Transport in Planetary Atmospheres. This poorly understood process controls the temperature structure of the lower atmosphere and largely determines weather conditions at the surface of the earth. A preliminary study of this problem has been undertaken.

Attached is a report on the financial status of this grant, as of November 30, 1963. This report includes a breakdown of expenditures by category. [redacted]